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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/780,517	02/17/2004	William A. Worstell	12355-010001 / Pet Scanne	1361

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EXAMINER	
ROSENBERGER, FREDERICK F	
ART UNIT	**PAPER NUMBER**
2884	

DATE MAILED: 02/22/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/780,517	WORSTELL, WILLIAM A.	
	Examiner	Art Unit	
	Frederick F. Rosenberger	2884	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *01 June 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-29* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-29* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *17 February 2004* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *6/1/04*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Information Disclosure Statement

1. The information disclosure statement filed 1 June 2004 fails to comply with 37 CFR 1.98(a)(2), which requires a legible copy of each cited foreign patent document; each non-patent literature publication or that portion which caused it to be listed; and all other information or that portion which caused it to be listed. It has been placed in the application file, but the information referred to therein has not been considered.

Specifically, foreign patent document GB 2,052,207 has not been received.

Drawings

2. New corrected drawings in compliance with 37 CFR 1.121(d) are required in this application because the drawings and reference numbers are handwritten. Applicant is advised to employ the services of a competent patent draftsperson outside the Office, as the U.S. Patent and Trademark Office no longer prepares new drawings. The corrected drawings are required in reply to the Office action to avoid abandonment of the application. The requirement for corrected drawings will not be held in abeyance.

3. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference sign(s) mentioned in the description: **15** (page 10, line 5). Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures

appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

4. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

5. The disclosure is objected to because of the following informalities: In the abstract, line 4, "block;" should probably be --block--.

Appropriate correction is required.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

7. Claims 1, 2, 12, and 13 are rejected under 35 U.S.C. 102(b) as being anticipated by Chang et al. (US Patent # 6,459,085).

With regards to claim 1, Chang et al. disclose a depth of interaction detection system for nuclear imaging comprising:

Photodetectors, in the form of PMT array **22** (Figure 3), disposed to receive photons from a scintillator **18** of a PET scanner (column 3, lines 41-43) and configured to provide a measured photodetector signal indicative of a distribution of photons detected by the photodetectors (column 4, lines 62-63; column 4, line 67 – column 5, line 1);

And wavelength-shifting fibers, in the form of wavelength-shifting scintillation fibers **12**, disposed to receive photons from the scintillator **18** and configured to provide a measured fiber signal indicative of the distribution of photons received by the fibers (column 5, lines 16-19; column 6, lines 2-7).

With regards to claim 2, Chang et al. further disclose a processor, in the form of processing electronics for both the PMT array and fiber photodetector array (Figure 3) and an external acquisition computer (not shown in figures; column 4, line 67 – column 5, line 1) configured to estimate the location of the photon source within the scintillation crystal in the x-y direction based on the PMT array signal (column 5, lines 36-39) and in the depth of interaction direction based on the fiber array signal (column 7, lines 11-16).

With regards to claim 12, Chang et al. disclose a method for scintillation event location detection in nuclear imaging comprising the steps of:

Obtaining a measured photodetector signal, using PMT array **22**, indicative of the distribution of photons received by the PMT array from a photon source on a scintillator block of a PET scanner (column 4, line 67 – column 5, line 1);

And obtaining a measured fiber signal, using fiber array **12** and associated photodetectors **33**, indicative of a distribution of photons received by the fiber array **12** extending across the scintillator block from a photon source on a scintillator block.

With regards to claim 13, Chang et al. further disclose the step of estimating the location of the photon source based on the measured PMT signal to determine the x-y coordinates (column 5, lines 36-39) and the measured fiber array signal to determine the depth of interaction direction (column 7, lines 11-16).

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

9. Claims 5, 16, and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chang et al. (US Patent # 6,459,085), as applied to claims 2 and 13 above.

With regards to claims 5 and 16, Chang et al. disclose all the limitations of parent claims 2 and 13, as discussed above. Chang et al. further disclose algorithms for determining the uncertainty associated with the event location measurement performed using the detected signal (column 11, line 15 – column 12, line 15). This uncertainty determination thus provides an estimate of the extent to which the calculated location is the correct location, i.e. large uncertainty values would reflect that the calculate location may not be the correct location.

With regards to claim 23, Chang et al. disclose a method for estimating the location of a photon source on a scintillator block comprising:

Obtaining a measured photodetector signal, using PMT array **22**, indicative of the distribution of photons received by the PMT array from a photon source on a scintillator block of a PET scanner (column 4, line 67 – column 5, line 1);

Obtaining a measured fiber signal, using fiber array **12** and associated photodetectors **33**, indicative of a distribution of photons received by the fiber array **12** extending across the scintillator block from a photon source on a scintillator block;

And, estimating the location of the photon source based on the measured PMT signal to determine the x-y coordinates (column 5, lines 36-39) and the measured fiber array signal to determine the depth of interaction direction (column 7, lines 11-16).

Chang et al. do not specifically mention a computer readable medium with software code for performing said method. However, Chang et al. do note the use of a computer system for processing the detected signal, as noted above. Chang et al. further note the use of numerical integration methodologies using a computer to execute a numerical integration program in the determination of the relationship between depth of interaction and the detected fiber array signal (column 7, lines 11-16). In addition, the use of computer readable medium with encoded software for executing a method is well known in the art in the medical imaging art. Thus, it would have been obvious for a person having ordinary skill in the art at the time the invention was made to provide for the execution of the given method using software encoded on computer readable media, since the use of computer readable media allows for ease in transportability of the method between similar apparatuses as well as allowing for relative ease in updating the desired method, as is well known in the art. Attention is directed to the relevant prior art references not used in the rejections (see Conclusion section below) for instances of computer readable media used in the execution of detection systems using scintillators.

10. Claims 3, 4, 6, 7, 14, 15, 17, 18, and 24-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chang et al., as applied to claims 2, 13, and 23 above, and further in view of Rogers et al. (US Patent # 4,959,809).

Chang et al. disclose all the limitations of parent claims 2, 13, and 23, as discussed above. However, Chang et al. are silent with regards to the processor

estimating the location of the photon source based on a reference signal, namely a stored calibration table containing the values derived from the set of known signals. Chang et al. do make reference to the determination of location in the depth of interaction direction using numeral integration of the fiber array signal.

Rogers et al. teach that the use of a lookup table in correlating detected signals with event location is well known in the art (column 1, lines 51-64). In situations where extensive numerical computation would be required to determine the event location based on the detected signal, such as the system proposed by Chang et al., a lookup table would save processing time by directly correlating the detected signals with corresponding position locations in a lookup table. Thus, it would have been obvious for a person having ordinary skill in the art at the time the invention was made to use a lookup table of known signals, both for the photodetector and fiber array signals, for estimating the location of a photon source since it was known that the use of lookup tables is well known in the art, as taught by Rogers et al., and, further, that the use of lookup tables can result in expedited processing times over repeated numerical integration computations.

11. Claims 8-11, 19-22, and 27-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chang et al., as applied to claims 2, 13, and 23 above, and further in view of Malmin et al. (US Patent # 5,847,395).

With regards to claims 8-11, 19-22, and 27-29, Chang et al. disclose all the limitations associated with parent claims 2, 13, and 23, as described above. Chang et

al. describe determining the probability of the depth of location of the scintillation event based on the fiber array signal (column 7, lines 11-16) as well as the determination of the x-y location of the event based on the PMT array (column 5, lines 37-39). However, Chang et al. do not specifically address determining the location of the photon source by estimating the likelihood that the detected light resulted from that source.

Malmin et al. disclose that it is common in scintillation systems to use the outputs from PMTs in combination with the outputs from other sensing elements to determine the location of the light from the scintillator (column 1, lines 38-42). Malmin et al. further disclose that the maximum likelihood method is commonly used in the determination of event location (column 1, lines 44-48). As is known in the art, the basic principle underlying the maximum likelihood method is to analyze the detector responses and determine through specific algorithms the location of the light source that would maximize the probability of obtaining the detected responses (see cited pertinent prior art in the Conclusions section below). As such, the use of the maximum likelihood method would include determining a position from the likelihood that the measured signals occurred at a single source, determining the position from a maximum likelihood from a plurality of sources, or estimating first and second likelihoods based on different source locations and choosing the one based on the greater likelihood.

Thus, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to employ the maximum likelihood method in the determination of the location of the scintillation event (i.e. the light source) since it was well known in the art that such methods are often employed in determining event

locations in a scintillator using PMT detection signals in cooperation with other sensing elements, as taught by Malmin et al.

Conclusion

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Gagnon et al. (Journal paper entitled "Maximum Likelihood Positioning in the Scintillation Camera Using Depth of Interaction") discusses the location of a scintillation event within a scintillator using the maximum likelihood theory, wherein the method is "to select, for a set of observed PM responses, the position of scintillation which would maximize the probability of obtaining such PMTs responses".

Vickers et al. (US Patent # 5,506,408) disclose a gamma camera that employs separate wavelength shifting fibers and photomultiplier tubes to receive light from a scintillation event.

DiFilippo (US Patent # 6,078,052) discloses a scintillation detector using a PMT coupled to a scintillation crystal along with an array of four wavelength shifting fibers coupled to the crystal.

Oka et al. (US Patent # 5,780,856) disclose a radiation detector employing two wavelength-shifting fibers for determination of the location of a scintillation event using detected pattern matching.

Kerschner (US Patent # 6,853,707) discloses the use of computer readable media in an X-ray detection system.

Aarsvold et al. (Journal paper entitled "Implementations of Maximum Likelihood Position Estimation in a Four-PMT Scintillation Detector") teaches the use of maximum-likelihood position estimation in conventional PMT scintillator detectors as well as the use of look-up tables in determining event location.

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Frederick F. Rosenberger whose telephone number is 571-272-6107. The examiner can normally be reached on Monday-Friday 8:00 AM - 5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Porta can be reached on 571-272-2444. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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